

XV.—*On the Systematic Relations of the Carnivora Fissipedia.* By E. D. COPE*.

THIS order embraces the clawed Mammalia with transverse glenoid cavity of the squamosal bone, confluent scaphoid and lunar bones of the carpus, and well-developed cerebral hemispheres. It is well distinguished from all others at present known; but such definition is likely to be invalidated by future discovery. Some of the Insectivora possess a united scapholunar bone; but the reduction of the cerebral hemispheres of such forms distinguishes them. The presence of the crucial fissure of the hemispheres is present under various modifications in all Carnivora, while the parieto-occipital and calcarine fissures are absent.

The many types of existing Carnivora fall into natural groups which are of the grade termed family in zoology. But the distinction of these from each other is not easily accomplished, nor is it easy to express their relations in a satisfactory manner. The primary suborders of Plinipedia and Fissipedia are easily defined. Various characters have been considered in ascertaining the taxonomy of the more numerous Fissiped division. The characters of the teeth, especially the sectorials, are important, as is also the number of the digits. Turner † has added important characters derived from the foramina at the base of the skull and the otic bulla, which Flower ‡ has extended. Garrod § has pointed out the significance of the number of convolutions of the middle and posterior part of the hemispheres. I have added some characters derived from the foramina of the posterior and lateral walls of the skull ||. Mr. Turner also defines the families by the form and relations of the paroccipital process.

In studying the extinct Carnivora of the Tertiary period it has become necessary to examine into the above definitions in order to determine the affinities of the numerous genera which have been discovered. To take them up in order, I begin with the foramina at the base of the skull. The result of my study of these has been that their importance was not overrated by Mr. Turner, and that the divisions of secondary rank indicated by them are well founded. Secondly, as to the

* From the 'Proceedings of the American Philosophical Society,' vol. xx. no. 112, p. 471, having been read before the American Philosophical Society on October 20, 1882.

† Proc. Zool. Soc. Lond. 1848, p. 63.

‡ *Loc. cit.* 1869, p. 5.

§ *Loc. cit.* 1878, p. 377.

|| Proc. Amer. Phil. Soc. 1880.

form and structure of the auditory bulla. Although the degree and form of inflation are characteristic of various groups of *Carnivora*, they cannot be used in a systematic sense, because, like all characters of proportion merely, there is no way of expressing them in a tangible form. For if the forms in question pass into each other, the gradations are *insensible*, and not sensible, as is the case with an organ composed of distinct parts. The same objection does not apply so much to the arrangement of the septa of the bulla. The septum is absent in the *Arctoidea* of Flower (*Ursidæ* of Turner), small in the *Cynoidea*, Flower (*Canidæ*, Turner), and generally large in the *Æluroidæ*, Flower (*Felidæ*, Turner). But here occurs the serious discrepancy that in the *Hyænidæ*, otherwise so nearly allied to the *Felidæ*, the septum of the bulla is wanting. Nevertheless the serial arrangement of the order indicated by Flower, viz. commencing with the *Arctoidea*, following with the *Cynoidea*, and ending with the *Æluroidæ*, is generally sustained by the structure of the auditory bulla and by the characters of the feet and dentition, as well as of the cranial foramina. Turner's arrangement in the order, *Ursidæ*, *Felidæ*, and *Canidæ*, is not sustained by his own characters; and its only support is derived from Flower's observations on the external or sylvian convolution of the hemisphere of the brain*. There are three simple longitudinal convolutions in the raccoons; in the civets and cats the inferior convolution is fissured at the extremities, while in the dogs it is entirely divided, so that there are four longitudinal convolutions between the sylvian and median fissures.

An important set of characters hitherto overlooked confirms Flower's order. I refer to those derived from the turbinal bones. In the ursine and canine forms generally the maxilloturbinal is largely developed, and excludes the two ethmoturbinals from the anterior narial opening. In the Feline group, as arranged by Turner, the inferior ethmoturbinal is developed at the expense of the maxilloturbinal, and occupies a part of the anterior narial opening. These modifications are not, so far as my experience has gone, subject to the exceptions seen in the development of the otic septa and molar teeth, while they coincide with their indications. The seals possess the character of the inferior group, or *Ursidæ*, in a high degree.

The characters derived from the paroccipital process are of limited application, as the study of the extinct forms shows.

I would then divide the fissiped *Carnivora* into two tribes, as follows:—

* Proc. Zool. Soc. Lond. 1869, p. 482.

External nostril occupied by the complex maxilloturbinal bone; ethmoturbinals confined to the posterior part of the nasal fossa; the inferior ethmoturbinal of reduced size	HYPOMYCTERI.
External nostril occupied by the inferior ethmoturbinal and the reduced maxilloturbinal	EPIMYCTERI.

While no doubt transitional forms will be discovered, the types at present known fall very distinctly into one or the other of these divisions. The characters are readily perceived on looking into the nares of well-cleaned specimens. The Hypomycteri stand next to the Pinnipedia, since the maxilloturbinal bone has the same anterior development in that group.

In searching for definitions of the families it is necessary to be precise as to the definition of terms. The meaning of the word sectorial is in this connexion important, since there are so many transitional forms between the sectorial and tubercular tooth. A sectorial tooth then of the upper jaw is one which has at least two external tubercles, which are the homologues of the median and posterior lobes of the sectorial of the cat. By the flattening and emargination of their continuous edges the sectorial blade is formed. One or two interior and an anterior lobe may or may not exist. In the genera of the Procyonidæ, except in *Bassaris*, the two external tubercles do not form a blade. The inferior sectorial tooth differs from the tubercular only in having an anterior lobe or cusp, which belongs primitively to the interior side. The inferior sectorial teeth with large heels, as in Viverridæ and Canidæ, I have called tubercular sectorials. The sectorial blade is formed by the union and emargination of the edges of the anterior and the principal external cusp. This blade is not well developed in the genus *Cynogale*, and still less in the Procyonidæ and Ursidæ. The families are then defined as follows:—

HYPOMYCTERI.

I. No sectorial teeth in either jaw.	
Toes 5 . 5	<i>Cercoleptidæ.</i>
II. Sectorial teeth in both jaws.	
a. Toes 5 . 5.	
β. No alisphenoid canal.	
True molars $\frac{2}{2}$	<i>Procyonidæ.</i>
" " $\frac{1}{2}$	<i>Mustelidæ.</i>
ββ. An alisphenoid canal.	
Molars quadrate, $\frac{2}{2}$	<i>Æluridæ.</i>
Molars longitudinal, $\frac{2}{3}$	<i>Ursidæ.</i>
aa. Toes 5 . 4 or 4 . 4	
Sectorials well developed, an alisphenoid canal	<i>Canidæ.</i>

EPIMYCTERI.

- I. Molars haplodont.
 Toes 5 . 4 ; no alisphenoid canal *Protelidæ*.
- II. Molars bunodont, no sectorials.
 Toes 5 . 5 ; an alisphenoid canal *Arctictidæ*.
- III. Molars bunodont, with sectorials.
- a. Otic bulla with septum.
- β. Alisphenoid canal and postglenoid foramen present.
- γ. True molars well developed.
- Toes 5 . 5 *Viverridæ*.
 Toes 5 . 4 *Cynictidæ*.
 Toes 4 . 4 *Suricutidæ*.
- γγ. True molars much reduced.
- Toes 5 . 5 *Cryptoproctidæ*.
 Toes 5 . 4 *Nimravidæ*.
- ββ. No alisphenoid canal; postglenoid foramen rudimental or wanting.
- Toes 5 . 4 *Felidæ*.
 aa. Otic bulla without septum.
- No alisphenoid canal nor postglenoid foramen: toes
 4 . 4 *Hyænidæ*.

The genera of these families are the following :—

- CERCOLEPTIDÆ: *Cercoleptes*. Neotropical.
- PROCYONIDÆ: *Procyon**, *Bassaricyon*, *Bassaris*. Ne-
 arctic and Neotropical.
- MUSTELIDÆ: *Melina* (two tubercles of internal side of
 superior sectorial)—*Taxidea*, *Meles*; *Mustelina* (one
 internal tubercle of superior sectorials)—*Enhydris*,
Pteronura, *Lutra*, *Aonyx*, *Barangia*, *Helictis*, *Zorilla*,
Mephitis, *Conepatus*, *Mellivora*, *Gulo*, *Galictis*, *Puto-
 rius*, *Mustela*.
- ÆLURIDÆ: *Ælurus*, *Æluropoda*, ? *Hyænarctos*.
- URSIDÆ: *Helarctos*, *Arctotherium*, *Ursus*, *Melursus*.
- CANIDÆ: *Megalotis* †, *Amphicyon*, *Thous*, *Paleocyon*,
Temnocyon, *Galecynus*, *Canis*, *Vulpes*, *Enhydrocyon*,
Hyænocyon, *Brachycyon*, *Tomarctus*, *Speothus*, *Syna-
 godus*, *Dysodus*, *Oligobunis*, *Icticyon*, *Lycæon*.
- PROTELIDÆ: *Proteles*. Ethiopian.
- ARCTICTIDÆ: *Arctictis*. Indian.
- VIVERRIDÆ: *Cynogale*, *Arctogale*, *Paguma*, *Paradox-
 urus*, *Nandinia*, *Hemigale*, *Galidia*, *Prionodon*, *Ge-
 netta*, *Viverricula*, *Viverra*, *Galedictis*, *Herpestes*,

* Including *Nasua*, which is not distinct.

† This genus cannot be made the type of a family, as is done by Dr. Gray.

Athylax, *Calogale*, *Ichneumia*, *Bdeogale*, *Urva*,
Tæniogale, *Onychogale*, *Helogale*, *Rhinogale*, *Mungos*,
Crossarchus, *Eupleres*.

CYNICTIDÆ: *Cynictis*, ? *Ictitherium*.

SURICATIDÆ: *Suricata*. Ethiopia.

CRYPTOPROCTIDÆ: *Proaelurus*, *Cryptoprocta*.

NIMRAVIDÆ: *Archaelurus*, *Nimravus*, *Ælurogale*, *Di-*
nictis, *Pogonodon*, *Hoplophoneus*.

FELIDÆ: *Machærodontinæ*—*Machærodus*, *Smilodon* ;
Felinæ—*Plethælorus* (g. n.)*, *Catolynx*, *Felis*, *Neo-*
felis, *Uncia* †, *Lynx*, *Cynælorus*.

HYÆNIDÆ: *Hycænictis*, *Hycæna*, *Crocota*.

XVI.—*Notes on the Mollusca in the Great International Fisheries Exhibition, London, 1883, with the Description of a new Species of Pleurotoma.* By J. GWYN JEFFREYS, LL.D., F.R.S.

THE interest taken by the public in this great world's show continues unabated. But it does not seem to have attracted the attention of conchologists; although the contrary might have been expected, seeing that many of our rarest shells have been procured from the stomachs of fishes and even been caught by the bait intended for the latter.

Apart from the economic or food-supplying object of the Exhibition, there is not much of science or natural history in the department of Mollusca. Oysters, of course, play a considerable and aristocratic part in it, and are amply displayed. Not so with mussels, cockles, whelks, periwinkles, and other "small deer," which are so relished by the poorer classes in the dog days.

The Mollusca are well known to constitute, together with Crustacea, Annelids, and various other invertebrate animals, the principal food of most fishes. I have myself seen between thirty and forty specimens of the common whelk (*Buccinum undatum*) taken from the stomach of a single cod. Örsted says, in his interesting treatise 'De regionibus marinis,'

* Type *Felis planiceps*, Vig. Horsf. Char. Second (first) superior pre-molar two-rooted; orbit closed behind; pupil round.

† Mr. Wortman has called my attention to a character of this genus which confirms its separation from *Felis*, as I proposed in 1879. The maxilloturbinal bone is less complex in the genus *Uncia* than in *Felis*, consistently with a less nocturnal habit and less necessity for acute smell.